



A Traffic Safety Evaluation of California's Traffic Violator School Citation Dismissal Policy

April 2007

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.			
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE April 2007	3. REPORT TYPE Final Report	
4. TITLE AND SUBTITLE A Traffic Safety Evaluation of California's Traffic Violator School Citation Dismissal Policy		5. FUNDING NUMBERS	
6. AUTHOR(S) Michael A. Gebers			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) California Department of Motor Vehicles Research and Development Branch P.O. Box 932382 Sacramento, CA 94232-3820		8. PERFORMING ORGANIZATION REPORT NUMBER CAL-DMV-RSS-07-223	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Office of Traffic Safety 7000 Franklin Boulevard, Suite 400 Sacramento, CA 94232-3820		10. SPONSORING/MONITORING AGENCY REPORT NUMBER TR0403	
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION/AVAILABILITY STATEMENT		12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This study applied methodological refinements to the 1991 departmental evaluation of the traffic violator school (TVS) citation dismissal policy. This study identified and compared two large samples of drivers either completing a TVS ($N = 210,015$) or convicted of a traffic citation ($N = 168,563$). Prior to adjudication, the TVS group had characteristics (e.g., lower prior conviction rate and smaller proportion of males) that were predictive of a lower subsequent crash risk. However, the TVS group exhibited significantly more crashes than did the convicted group in the subsequent one-year period. The difference (4.83%) increased to 10% after adjusting for the more favorable characteristics of the TVS group. The TVS group also had a higher adjusted subsequent crash rate at each prior driver record entry level, reflecting a loss in the general and specific deterrence of the non-conviction masked status of TVS dismissed citations. It was also demonstrated that approximately 15,000 Negligent Operator Treatment System (NOTS) Level 3 (probation/suspension hearings) and 6,000 NOTS Level 4 (probation violator sanctions) interventions are circumvented annually because of TVS dismissals. The demonstrated effectiveness of the NOTS interventions in reducing crash risk of treated drivers assists in explaining why the driving public is exposed to an increased crash risk as a result of their avoidance. A number of recommendations are offered to reduce the negative traffic safety impact of the TVS citation dismissal policy.			
14. SUBJECT TERMS traffic safety, motor vehicle crashes, crash prevention, evaluation, crash risk forecasting, traffic law violators, driver improvement schools, point system, convictions		15. NUMBER OF PAGES 35	
17. SECURITY CLASSIFICATION OF REPORT Unclassified		16. PRICE CODE	
18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified		20. LIMITATION OF ABSTRACT None

PREFACE

This project is part of the California Traffic Safety Program and was made possible through the support of the California Office of Traffic Safety, State of California, and the National Highway Traffic Safety Administration. The report was prepared by the Research and Development Branch of the California Department of Motor Vehicles. The opinions, findings, and conclusions expressed in this publication are those of the author and not necessarily those of the State of California or the National Highway Traffic Safety Administration.

ACKNOWLEDGMENTS

The author wishes to acknowledge with appreciation the individuals who contributed to this project.

The study was conducted under the general direction of David DeYoung, Research Chief, and the supervision of Robert Hagge, Research Manager II. Karen Coyle and Janice Masterton of the Office of Traffic Safety were very helpful in guiding the project's grant process. Assistance in computer programming for the extraction of the data was provided by Mary Ramirez, ISD Programmer. Appreciation goes to both Debbie McKenzie, Associate Governmental Program Analyst, and to Douglas Luong, Staff Services Analyst, for their help in typing and proofing the many drafts of this report.

The author would like to extend his thanks to Jeffrey Bingenheimer, PhD., of the Department of Health Behavior and Health Education at the University of Michigan School of Public Health for providing the programming code and supporting documentation used as a model for the present study's sensitivity analysis. The author would also like to thank Raymond C. Peck of R.C. Peck and Associates, and a former Chief of the Research and Development Branch, for his review and input of an early draft of the study's sampling and evaluation plan.

Finally, the author would like to thank Kathy Kelly, Manager of the Licensing Policy Branch, for her recommendations for improving the traffic safety efficacy of California's traffic violator school program.

EXECUTIVE SUMMARY

Background

- Courts in California may offer drivers cited for traffic violations the opportunity to attend a traffic violator school (TVS) in lieu of conviction. Those who return to the court with proof of course completion have their citations dismissed and masked from public inspection. Because there is no conviction of a violation, these TVS drivers do not have negligent-operator (neg-op) points added to their driving records by the California Department of Motor Vehicles (DMV).
- The number of drivers attending TVS courses has been increasing. For example, in year 2005, approximately 1,233,327 drivers completed a TVS course as compared to 939,719 drivers completing a TVS course in 1996, an increase of 31%. TVS dismissals represent about 25% of the total number of traffic violation abstracts reported to the department by the courts.
- The traffic safety value of the TVS citation dismissal policy has been questioned in several prior California DMV studies. For example, a 1979 study found no evidence that TVS programs had any impact on subsequent crash and citation rates. A 1987 study reported that TVS dismissals result in an increase in crashes compared to the effects of conventional adjudication (traffic conviction). A 1991 study presented evidence that the TVS group had a significantly higher (by 10.2%) crash rate than did a comparison group of convicted drivers after statistically adjusting for the more favorable preexisting characteristics of the TVS group. Three other department studies (1993, 1999, & 2003) found that TVS dismissals in combination with other risk factors increase traffic crash propensity beyond that of drivers who meet the state's *prima facie* definition of a negligent operator.
- These prior studies are consistent with the hypothesis that the TVS citation dismissal policy may result in increased crashes as the result of a loss in deterrence due to drivers' avoiding both the department's license control interventions, as well as an increase in insurance premiums. In addition, the masking of violation dismissals through the TVS option results in a distortion of the accuracy of the department's records in predicting future crash risk.

Project Objectives

The current study was designed to further explore the effects of the TVS program on traffic safety through the use of a quasi-experimental design employing methodological refinements to the design used for the department's last TVS traffic safety evaluation completed in 1991.

Research Design

The data analyses evaluated the safety impact of TVS citation dismissals by comparing two groups of drivers, those receiving a TVS dismissal and those who received a traffic conviction. A propensity score technique was used to adjust the 1-year subsequent crash rates for these two groups to control for pre-existing differences between them on biographical (e.g., age and gender) and prior driving record variables (e.g., prior total crashes and citations). Estimates were also produced in relation to the number of the department's Negligent Operator Treatment System (NOTS) Level 3 (suspension/probation) and Level 4 (probation violator) interventions circumvented by TVS dismissals.

The following groups of drivers sampled from the department's Driver License Master File were included in the analyses:

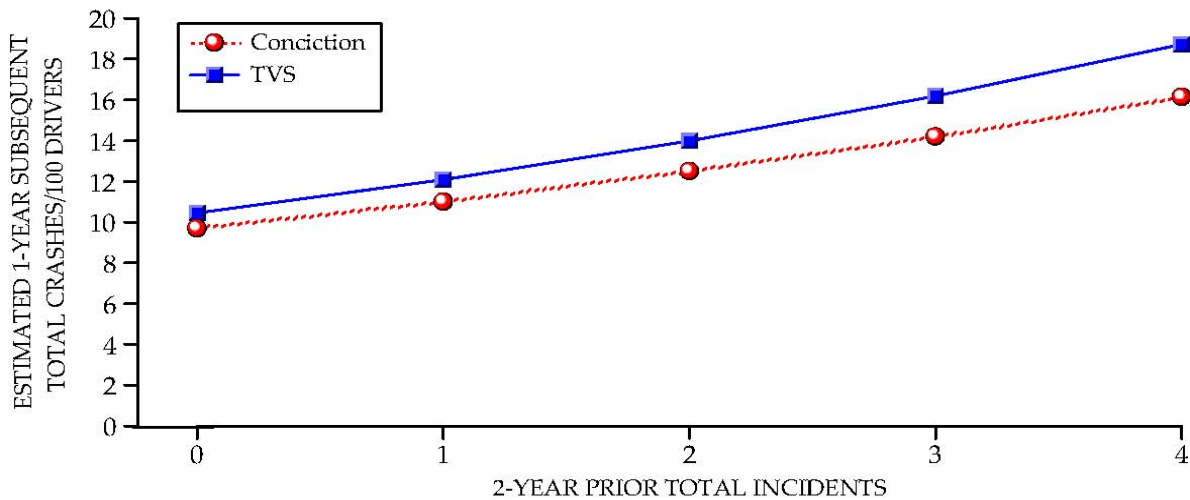
1. Drivers who attended a traffic violator school and had a moving (1-point) traffic violation dismissed (TVS subjects).
2. Drivers who received a conviction for a 1-point moving violation (conviction subjects).
3. Negligent operators who received NOTS post-license control interventions (NOTS subjects).
4. Drivers who received a TVS citation dismissal associated with countable (1- or 2-point) or non-countable (0-point) violations (TVS Finder Record subjects).

Results

The results of the current study were consistent with prior departmental evaluations reporting a negative traffic safety impact associated with the TVS citation dismissal policy. The study's analyses answered five questions. The questions and their answers are summarized in the following:

1. What are the characteristics of drivers attending TVS and how do they differ from the characteristics of traffic violators who receive standard adjudication (i.e., traffic conviction)?
 - Prior to course assignment and completion, TVS drivers have characteristics associated with a lower subsequent crash propensity as compared to drivers receiving a conviction. TVS drivers have better driving records and are more likely to be older and female.
2. Are TVS attendees as a group more, less, or equally likely to be involved in future crashes than are violators who instead receive a traffic conviction?

- Despite the above characteristics, TVS drivers have a significantly higher (by about 5%) 1-year subsequent crash rate than do convicted drivers.
3. Is the law allowing violators to avoid accumulating traffic convictions by attending TVS associated with a decrease or increase in traffic crash risk?
- Propensity score adjustment of the TVS and convicted groups' subsequent crash rates to control for the initial lack of equivalence between the groups increased the magnitude of the difference between the rates. After the adjustment, the TVS group had a 1-year total crash rate that was significantly higher (by 10%) in comparison to the convicted group. This outcome strongly suggests that the TVS citation dismissal policy is associated with an increased crash risk.
 - The TVS group also had a higher propensity-score-adjusted subsequent crash rate at each level of prior traffic convictions/crashes. For example, among drivers with four prior driver record entries, the TVS group had 18.73 subsequent total crashes per 100 drivers while the conviction group had 16.15 total crashes per 100 drivers. The accompanying relative risk ratio of 1.16 indicates that the rate for TVS drivers with four prior entries is 1.16 (or 16%) higher than the rate for convicted drivers with four prior entries. The adjusted crash rates for both groups at each prior driver record entry level are illustrated in the following figure.



Note. Prior incidents include all convictions, TVS dismissals, FTAs, and crashes, except the incident resulting in treatment assignment.

Figure. Estimated propensity-score-adjusted 1-year subsequent total crash rate by group and 2-year prior total incidents.

4. How many crashes are prevented or created each year by the TVS citation dismissal policy and what are the economic consequences of this effect?
 - It was estimated that the negative effect of the TVS citation dismissal policy results in approximately 12,300 additional crashes annually. The net annual economic loss associated with these crashes is estimated to be approximately \$398,000,000.
5. How many of the Department's Negligent-Operator Treatment System actions are circumvented annually due to drivers receiving one or more TVS dismissals?
 - It was demonstrated that approximately 15,000 Level 3 (suspension/probation) and 6,000 Level 4 (probation violator sanction) NOTS interventions are circumvented annually by TVS dismissals. The demonstrated effectiveness of the NOTS interventions in reducing crash risk of treated drivers largely explains why the driving public is exposed to an increased crash risk as a result of the avoidance of these sanctions.

Conclusions/recommendations

The results of the current study closely parallel the findings from the department's prior traffic safety evaluations of the TVS citation dismissal policy that demonstrate that any educational benefit from TVS instruction is not enough to offset the negative traffic safety impact of avoiding NOTS interventions made possible by the citation dismissal policy.

It is recommended that the following changes to current law and regulations be considered to reduce the negative traffic safety impact of the TVS citation dismissal policy. (The recommendations are in no particular order and may not be completely independent of each other.)

- Assign negligent-operator points for each TVS dismissal.
- Unmask the original TVS dismissal whenever a driver receives a second TVS dismissal or subsequent traffic conviction within 18 months.
- Require a driver to maintain a clean record (i.e., no convictions or culpable crashes) for 2 years prior to a violation that is dismissed by way of TVS completion.
- Eliminate the ability of the courts to dismiss more than one citation within any 18-month period via the TVS option.
- Eliminate the ability of the courts to improperly dismiss major (2-point) violations via TVS.

- Send warning and advisory letters to groups of TVS drivers who, on the basis of a combination of TVS dismissals and NOTS points, do not qualify for negligent-operator treatment system intervention, but who exceed the risk of *prima facie* negligent operators.

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INTRODUCTION

Background

Courts in California may offer drivers cited for traffic violations the opportunity to attend a traffic violator school (TVS) in lieu of conviction. Those who return to the court proof of TVS course completion have their citations dismissed and masked from their driving record. Because there is no conviction of a violation, these TVS drivers do not have negligent-operator (neg-op) points added to their driving records by the California Department of Motor Vehicles (DMV).

The number of drivers attending TVS courses has been increasing. For example, in 2005, approximately 1,233,327 drivers completed a TVS course, as compared to 939,719 drivers completing a TVS course in 1996, an increase of 31%.¹ TVS dismissals represent about 25% of the total number of traffic violation abstracts the courts reported to the department in 2005 (California Department of Motor Vehicles, 2006).

California Vehicle Code Section 42007 requires TVS drivers to pay a fee equal to the total bail set for the eligible offense on the uniform countywide bail schedule. This fee does not include the cost of TVS enrollment.

In California, there is no legal statewide limit on the number of times that a driver may receive a TVS dismissal, although individual counties may establish their own policy.² However, only the first TVS dismissal within an 18-month period is “masked” from the public driving record (e.g., not available to prospective employers or insurers). Although second and subsequent TVS dismissals within an 18-month period appear on the public driving record, they cannot be assigned neg-op points by DMV.

Courts favor the current TVS dismissal option, as evidenced by the large number granted each year, and there are several likely reasons for this. One reason is that the dismissal option expedites court processing and promptly clears court dockets. The large and increasing caseloads in many courts make this feature highly attractive. Another reason is that TVS dismissals enable some drivers to avoid licensing actions (e.g., suspension or revocation) and higher insurance premiums that would be triggered by a traffic conviction, which courts may perceive as being excessive or unjustified. Finally, some courts may simply believe that TVS schools have traffic safety value

¹For the purposes of this report, TVS dismissals refer to all court reported abstracts that are dismissed under California Vehicle Code Sections 1803.5 and 1808.7. These dismissed abstracts follow the referred violators’ successful completion of TVS courses that offer an approved curriculum and are licensed by DMV as well as other court-approved programs of driving instruction (e.g., internet traffic schools).

²Although language in one section of California Court Rule 4.104 seems to prohibit a judge from sending a driver to TVS more than one time in 18 months, language in another section of California Court Rule 4.104 gives a judge the discretion to do so.

through an assumed or alleged improvement in driver knowledge or attitudes. However, as demonstrated below, there is no substantiated scientific evidence that driver improvement courses reduce the risk of future crashes.

The increasing court use of TVS dismissals and their high volume are unsettling in light of the strong evidence from prior DMV studies that the citation dismissal policy has a negative traffic safety impact.

In 1979, the department published a report that evaluated the effectiveness of accredited traffic violator schools in reducing crashes and violations (Peck, Kelsey, Ratz, & Sherman, 1979). Approximately 14,000 violators cited for traffic offenses unrelated to alcohol were randomly assigned to a group that attended a TVS course (treatment group) or to a group that did not (control group). The results indicated that TVS attendance had no statistically significant effects on subsequent 6-month crashes or convictions. The report concluded that, although it could not be inferred that all TVS programs are ineffective, the results raised strong doubts about the efficacy of most traffic schools.

These results were further substantiated by the findings of a 1987 departmental report that evaluated the effects of TVS dismissals on crash risk assessment and license control actions. Gebers, Tashima, and Marsh (1987) found that although only about 4% of the 740,000 violators who completed TVS in 1986 had two-or-more dismissals in one year, the data clearly show that loss of information about the 96% of drivers who received just one dismissal in one year reduced the validity of convictions as a predictor of future crash risk. For example, the TVS drivers with no convictions had nearly 2.5 times as many crashes as a randomly sampled population of drivers with no convictions. It was estimated that annual traffic crash involvements in California were under-predicted by approximately 42,000 because of TVS dismissals. Although the lack of a “true” control or comparison group precluded being able to definitively answer whether the TVS programs reduced subsequent crash risk, the analysis did show that a TVS dismissal was associated with a slightly higher crash risk than that associated with a traffic conviction.

A third departmental study compared groups of drivers who either completed a TVS course or were convicted of a moving violation over a 3-year period (Peck & Gebers, 1991). The TVS group had many biographical and driver characteristics that ordinarily would be predictive of a lower subsequent crash expectancy. Despite this finding, the TVS group had a significantly higher (by 7.1%) crash rate than did the conviction group in the subsequent 1-year period. This difference increased to 10.2% after statistically adjusting the crash rates to control for the more favorable preexisting characteristics of the TVS group.

Two other departmental studies addressed the relationship between TVS dismissals

and subsequent crash risk. Gebers (1999) and Gebers and Peck (2003) found that prior TVS dismissals, when combined with convictions, crashes, and other risk factors, increase predicted crash risk beyond that expected for drivers who meet the state's prima facie definition of a negligent operator.

Perhaps the more immediate concern related to the TVS program is that it hampers the department's ability to assess crash risk through the neg-op point system and the administering of appropriate license control actions. Results of a 1993 DMV study by Gebers, Peck, Janke, and Hagge provide additional evidence that the TVS dismissal policy reduces the effectiveness of DMV's point system in identifying high-risk drivers and treating them through the administration of appropriate license control actions. The study demonstrated that counting TVS dismissals as selection incidents or neg-op points would result in targeting higher-risk driver groups for licensing actions than those acted on by the neg-op treatment system in place at the time of the study. Since these license control actions have been found to be effective in several prior departmental evaluations, circumventing them would expose the public to increased crash risk unless the diversion program were equally effective.

It is also obvious that TVS dismissals compromise the validity of using the driver record to estimate a driver's future crash risk for purposes of determining his or her possible eligibility for a "good driver" discount on their auto insurance premium. The policy of masking citation dismissals leads to potentially high-risk drivers not being identified. Consequently, other drivers may be subject to higher premiums to compensate for the TVS drivers' lower insurance rates, and this degrades the motivational value of the state's good driver merit system.

Studies by the department (Gebers, 1995) and the Automobile Club of Southern California (Bloch, 1996) evaluated the effects of a variety of TVS instructional methods on course attendees. Both studies demonstrated that the courses resulted in only a small improvement in the knowledge level of attendees and no significant change in their attitudes about safe driving. Both studies concluded that there was no significant relationship between knowledge level and subsequent crash involvement, or between attitude and driver record entries.

It should be noted that the above discussion does not address other possible sanctions associated with a traffic conviction most notably, insurance premium increases. The TVS dismissal policy enables many drivers to avoid these aversive consequences as well. Another concern is that the use of TVS dismissals allows drivers who would not otherwise have been eligible based on their total violation point count to renew their driver license under the state's renewal by mail eligibility criteria as specified in California Vehicle Code Section 12814.5. The loss of any deterrent impact by avoiding these consequences can only add to the negative traffic safety effect from the circumvention of license actions.

Not all evaluations of California's TVS citation dismissal policy have reported negative traffic safety effects. Kaestner (1986) evaluated the National Traffic Safety Institute's (NTSI's) Basic Level I and Advanced Level II Traffic Violator Workshops offered in Santa Clara County. Subjects were randomly assigned to the NTSI courses or to control groups. Driver records for all subjects in both groups were tracked for 1 year after course completion. For both Level I and Level II comparisons, the school assignees had fewer subsequent convictions than their control group counterparts, but only the effect of Level II was statistically significant. Kaestner interpreted these results as establishing the superiority of Level II over Level I. However, no statistical test result was reported showing that the Level II treatment effect was, in fact, significantly better than the Level I treatment effect. As noted by Gebers et al. (1987), any differences between the effects of the two treatments could be due to differences in the characteristics (including responsiveness to treatment) of the offenders assigned to the two programs.

Although random assignment of subjects to treatment or control groups will usually yield the most unbiased evaluation design, Kaestner's effort involved a critical flaw or artifact in the selection of drivers in the control group who received no convictions. Such a potential artifact was also present in the 1979 study by Peck et al., as noted by that author in the following excerpt (pp. 13-14):

Another matter of concern is the treatment given to control group subjects... These control procedures, of course, differ from what would occur if traffic violator schools did not exist. If there were no schools, violators would presumably be required to pay the fine and the conviction would become part of the public record available to insurance companies. In most cases this would also result in assessment of a point count by DMV. Because of the unusual procedures used in this study, the control group was not subject to the potential deterrent consequences of receiving a traffic conviction.

Of all these differences between the control group employed in the present study and a "real world" control group (one that was convicted and paid court fines), the authors believe that the conviction dismissal would have had the greatest impact. Had that proportion of control group subjects who should have become eligible for one of the department's negligent-operator programs received such treatment, prior evidence (Kadell & Peck, 1979) indicates that the subsequent control group means would have been lower than found here. Since traffic school attendance did not significantly improve driving records despite the advantage of not competing with a "true" control group, the efficacy of the program is further in doubt.

Objectives

The information presented above provides compelling rationale to question the justification of current statutes and policy that allow drivers to have traffic citations

dismissed and masked following completion of a TVS course. The present study was designed to further explore the effects of the TVS program on traffic safety through the use of a quasi-experimental design employing substantial methodological improvements to the design used for the department's last TVS traffic safety evaluation completed in 1991.

This current study addresses the following five questions:

1. What are the characteristics of drivers attending TVS and how do they differ from the characteristics of traffic violators who receive standard adjudication (i.e., traffic conviction)?
2. Are TVS attendees as a group more, less, or equally likely to be involved in future crashes than are violators who instead receive a traffic conviction?
3. Is the law allowing violators to avoid accumulating traffic convictions by attending TVS associated with a decrease or increase in traffic crash risk?
4. How many traffic crashes are prevented or created each year by the TVS citation dismissal policy and what are the economic and societal consequences of this effect?
5. How many of the department's Negligent-Operator Treatment System (NOTS) actions (i.e., warning letter, notice of intent to suspend, and license probation/suspension/revocation) are circumvented annually due to drivers receiving one or more TVS dismissals?

Although questions 2 and 3 may appear to be asking the same question, they are really fundamentally different. Question 2 refers to the use of TVS as an actuarial indicator of crash risk, irrespective of cause. One may be inclined to hypothesize that persons opting for TVS attendance have more positive safety attitudes and higher socioeconomic status than those who do not choose this option, thereby resulting in TVS drivers' having lower subsequent crash rates even if TVS had no causal positive or negative influence on their driving performance (reflecting a self-selection bias). Question 3, in contrast, asks whether or not any observed difference in crash risk between the TVS and conviction groups can likely be attributed directly to the educational or motivational effects of traffic violator school attendance. Answering this question with greater certainty requires that any preexisting difference in the crash propensities of the two groups be eliminated or statistically controlled to the extent possible.

METHODS

This section presents an overview of the methodology used to evaluate the traffic safety impact of the TVS citation dismissal policy. Some methodological details are reserved for the Results section because they are more understandable in the context of the findings.

Group Selection Methodology

Four groups of subjects were selected for the study. Only individuals who had a California driver's license number were included. The four groups are:

1. Drivers who attended a traffic violator school and had a moving (1-point) traffic violation dismissed (TVS subjects);
2. Drivers who received a conviction for a 1-point moving violation (conviction subjects);
3. Negligent operators who received NOTS post license control interventions (NOTS subjects);
4. Drivers who received a TVS citation dismissal associated with a countable (1- or 2-point) or non-countable (0-point) violation (TVS Finder Record subjects).

TVS and conviction subjects. For study validation purposes, these subjects were divided into two samples based on driver license number. One sample was used for the study's primary traffic safety impact analyses, and the other was used for replication analyses. Drivers with a driver license number ending with the number 3 were assigned to the primary analyses, and drivers with a driver license number ending with the number 5 were assigned to the replication analyses.

The subjects used for the primary analyses consisted of a group of 210,015 TVS drivers and a comparison group of 168,563 convicted drivers. The subjects used for the replication analyses consisted of a group of 209,884 TVS drivers and a comparison group of 168,312 convicted drivers. All subjects were selected from the department's automated Driver License Master File in April of 2003.

In assigning drivers to the primary and replication analyses, only California convictions and TVS dismissals associated with 1-point, safety-related violations (e.g., speeding, following too close, and sign and signal violations) were considered; 2-point "major" California convictions (e.g., DUI, hit-and-run, and reckless driving), out-of-state convictions, failures-to-appear in court (FTAs), and crashes were ignored. Assignment to groups was made based on which type of incident (conviction or dismissal) came first. The TVS subjects were drivers whose initial incident during 2000-01 was a TVS

dismissal; this dismissal was defined as their “critical incident” for establishing the TVS designation. The conviction subjects were drivers whose initial incident during 2000-01 was a 1-point conviction of a moving violation; this conviction was defined as their critical incident for conviction designation.³ The citation (violation) dates were used to anchor the convictions and TVS dismissals in time. Driving records for the selected drivers were summarized within two time periods bracketing the citation date of the critical incident (conviction or TVS dismissal). The first or “pre” period is 2 years prior to the critical incident date. The second or “post” period is 1 year subsequent to that date.

NOTS Subjects. This group consisted of 47,465 drivers who were randomly selected from the Enhanced Negligent Operator Treatment Evaluation System (ENOTES) database.⁴ These subjects had received a NOTS action for one or more of the first three treatment intervention levels (warning letter, notice of intent to suspend, or a probation/suspension action). They also had a conviction updated at the DMV between January 1, 2002 and December 31, 2002.

TVS Finder Record Subjects. 106,649 drivers, constituting a 10% random sample of all drivers who had a TVS dismissal updated at DMV in year 2002, were selected from the department’s TVS Finder Record Database, which contains data for all drivers who received dismissals under California Vehicle Code Sections 1803.5 or 1808.7. All subjects in the NOTS group described above were excluded from this selection to prevent double counting.

Research Design

This section describes the analyses that were done to answer the five principal questions posed in the Introduction section.

The analyses for questions 1, 2, and 3 involved the TVS and conviction subjects defined above: (1) TVS subjects whose first citation incident during January 1, 2000 through December 31, 2001 resulted in a TVS dismissal, and (2) convicted subjects whose first citation incident during January 1, 2000 through December 31, 2001 resulted in a 1-point conviction.

³Drivers who received a 1-point conviction as their first incident were used as a comparison group because traffic violators are normally assigned to TVS as a result of safety-related moving violations that would have resulted in a 1-point conviction had they not attended TVS. Gebers (2006) reported that nearly 98% of TVS citation dismissals are associated with 1-point violations.

⁴The interested reader is referred to Gebers and Roberts (2004) for a detailed description and profile of drivers treated by NOTS, and to Peck and Healey (1995) for an historical summary of the efficacy of NOTS in reducing crashes and convictions of treated drivers.

Questions 1 and 2 were addressed by comparing the TVS and conviction subjects on demographic characteristics, 2-year prior driver record variables, and the rate of total crashes over a 1-year subsequent period. The results represent the net actuarial differences between the two groups, irrespective of cause.

Question 3 was addressed by using a propensity score stratification technique in an attempt to reduce bias in the comparison of the TVS and conviction subjects. The propensity score method is a matching strategy that is based on the approach described by Rosenbaum and Rubin (1983). The use of propensity score techniques is gaining in popularity in quasi-experimental research e.g., in studies by Berk & Newton (1985); Lieberman, Lang, Cohen, D'Agostino, Datta & Frigoletto (1996); and Stone, Obrosky, Singer, Kapoor, & Fine (1995). The interested reader is referred to DeYoung, Tashima, and Masten (2005) for a recent application of propensity scores in a departmental study evaluating the effectiveness of ignition interlock devices in California.

In the present study evaluating the traffic safety impact of the TVS citation dismissal policy, propensity scores can be perceived as conditional probabilities. That is, each propensity score represents the probability that a driver was in the TVS sample versus the convicted sample, which was estimated based on the driver's scores on a number of predictor variables or covariates. The following discussion presents the rationale for the use of the propensity score stratification technique in the present study to answer question 3.

In observational studies, like this one, researchers have little or no control over the treatment assignment. Individuals exposed to alternate treatments (TVS versus conviction in this study) may have large differences on one or more observed variables (covariates), which can lead to biased estimates of treatment effects. Even the use of traditional analysis of covariance (ANCOVA) statistical adjustments is very often inadequate to eliminate this bias.

The use of the propensity score technique tends to reduce bias by creating more balance between the two groups on the covariates. Implicit in its use is that there be no measured or unmeasured characteristic that predicts both treatment assignment and outcome independent of the estimated propensity score.

The present study used the propensity score stratification technique outlined by D'Agostino (1998). Specifically, answering question 3 involved two steps.

The first step was using multiple logistic regression analysis (SAS PROC LOGISTIC) to model group membership (TVS subjects coded as 1 and convicted subjects coded as 0). The interested reader is referred to Hosmer and Lemeshow (2000) for a detailed discussion of logistic regression. The procedure computed the criterion (group membership) logit score for each subject, which served as his or her propensity score. A

total set of 33 licensing, biographical, and driver record variables (e.g., license class, age, and prior traffic citations) served as predictors in the propensity score (logit) model. The propensity scores of all subjects were separated into quintiles (i.e. five strata).

The second step in answering question 3 involved constructing models for estimating the “treatment” effect of the TVS dismissal policy. A series of multiple negative binomial regression analyses (SAS PROC GENMOD) were conducted to determine if the policy of allowing violators to avoid accumulating traffic convictions by attending TVS is associated with a decrease or increase in subsequent crash risk. Since it has been widely reported in prior research that total traffic crashes are not normally distributed, but rather follow a negative binomial or over-dispersed Poisson distribution (in which the variance is larger in magnitude than the mean), negative binomial regression has emerged as a more viable statistical technique to model traffic crash frequency than the traditional ordinary least squares procedures such as analysis of covariance. The interested reader is referred to Kleinbaum, Kupper, and Muller (1988) for a detailed discussion of Poisson and negative binomial distributions and their respective regression modeling techniques.

The regression models for estimating the treatment effect included only a subset of the most important variables and the propensity score as predictors. Specifically, subsequent 1-year total crashes were regressed against the propensity score, 2-year prior total driving incidents (defined as the sum of traffic citations plus crashes), group membership (TVS versus convicted), and the interaction between group membership and 2-year prior total driving incidents.

Of particular interest in the present study is the potential interaction between group membership and prior driving incidents. It was anticipated (based on the results presented in the 1991 Peck and Gebers study cited earlier) that this interaction may be statistically significant.⁵ Specifically, it was anticipated that the direction of any interaction would indicate a tendency for the negative effect of the citation dismissal policy to become larger at higher prior-incident levels. This finding would suggest that at least a part of the increase in the negative effect is attributable to TVS drivers’ circumventing DMV neg-op license control actions, which are known to be effective crash deterrents.

It is important to note that while the propensity score stratification technique used to statistically equate groups in addressing question 3 is valuable in reducing bias, the technique cannot reduce or eliminate all bias. Because it is impossible to identify and

⁵A test of statistical significance allows one to determine the probability that an observed difference is due to chance alone. If this probability is sufficiently small, it is concluded that the difference is “real.” Unless otherwise stated, a difference in the present study was considered to be statistically significant when the probability of a difference that large or larger (in either direction) occurring by chance was less than 1 in 10 ($p < .10$).

isolate all of the dimensions on which the groups differ in a manner that might affect study results, a definitive cause and effect statement cannot be made regarding the effect of the TVS dismissal policy on crashes.

An in-depth sensitivity analysis was conducted to assess the possible extent of such a bias remaining after the propensity score adjustment. This analysis, conducted by creating a set of artificial confounding variables modeled by logistic regression, explored how large any remaining bias would need to be to have an appreciable effect on the conclusions. The results of the sensitivity analysis are briefly described in the current paper but are presented in depth in a technical monograph available to the interested reader upon request.

Question 4, determining how many crashes are prevented or created each year by the TVS dismissal policy and what the economic consequences of this effect are, was assessed by using the estimated effect size per driver (i.e., the difference between the estimated crash rates obtained from the negative binomial regression equation for the TVS and convicted drivers), the annual volume of TVS drivers, and the estimated crash costs.

Question 5 addresses the extent to which NOTS actions are circumvented by the TVS citation dismissal policy. Since the dismissal of traffic citations following TVS completion reduces the overall NOTS point count of TVS participants from what it otherwise would be, a corresponding decrease in the volume of NOTS interventions was expected. To determine the degree to which this reduction occurred, the NOTS and TVS finder record samples were used to estimate the number of NOTS Level 3 (probation with suspension) and Level 4 (probation violator sanction) actions that were circumvented by TVS dismissals.

RESULTS

Question 1 - What are the Characteristics of Drivers Attending TVS and How Do They Differ From Traffic Violators Who Receive Standard Adjudication (i.e., Traffic Conviction)?

Biographical and 2-year prior driver record data were extracted for the TVS and convicted groups from the Driver License Master File. Table 1 displays the biographical and prior driver record differences between the two groups before equating the groups by applying the propensity score stratification technique.

Table 1

Demographic and 2-Year Prior Driver Record Variables for the TVS
and Conviction Groups Before Propensity Score Stratification

Covariates	Treatment group means		%	t-statistic
	TVS (N = 210,015)	Conviction (N =168,563)		
Months between violation and judgment dates	4.01	3.99	0.50	1.64
Age	37.25	36.17	2.99	24.09***
% male	58.85	63.87	-7.86	-31.56***
% commercial Class A/B license	4.99	4.38	13.93	8.75***
Total citations	31.19	56.32	-44.62	-93.74***
Countable citations	22.18	39.02	-43.16	-80.13***
Major citations	0.85	0.96	-11.46	-3.82***
Total crashes	15.76	16.32	-3.43	-4.12***
Driving with a suspended/revoked (S/R) license	0.26	0.70	-62.86	-17.62***
Neg-op points	20.87	30.65	-31.91	-47.10***
TVS dismissals	7.10	15.12	-53.04	-77.31***
Days under an S/R action	10.52	22.38	-52.99	-44.51***
Days on probation	1.78	2.47	-27.94	-7.40***
Non HBD crashes	15.54	16.12	-3.60	-4.25***
% under an S/R action	4.46	8.58	-48.02	-52.06***
% DUI conviction	0.62	0.65	-4.62	-1.33
% reckless conviction	0.17	0.22	-22.73	-3.54***
% hit and run conviction	0.05	0.08	-37.50	-3.26**
% incident while under an S/R action	0.78	2.01	-61.19	-33.17***
% night crash involvement	1.24	1.40	-11.43	-4.18***
% weekend crash involvement	3.59	3.63	-1.10	-0.25
% Ran-off-road & hit-fixed-object crash involvement	0.76	0.89	-14.61	-4.73***
% multiple-vehicle crash involvement	7.85	8.13	-3.44	-3.19**
% fatal/injury crash involvement	3.80	4.02	-5.47	-3.42***
% under DUI S/R action	0.14	0.16	-12.50	-1.42
% under P&M S/R action	0.09	0.10	-10.00	-1.97*
% under NOTS S/R action	0.37	0.55	-32.73	-47.10***
% under no-insurance S/R action	0.44	0.74	-40.54	-12.14***
% under "other" S/R reason action	1.41	3.63	-61.16	-44.56***

Note. Entries for neg-op points and driving incidents that are not represented as percentages are averages per 100 drivers. The percentages representing differences between the two groups are based on convicted drivers as the reference group.

* .01 < p < .05. ** .001 < p < .01. *** p < .001.

The TVS and conviction groups differ significantly on almost all of the factors. For example,

- The TVS drivers were, on the average, slightly older than convicted drivers (37.25 versus 36.17 years).
- The TVS group had a lower percentage of males than did the conviction group (58.85% versus 63.87%).
- The TVS group had a slightly higher percentage of commercial class (heavy vehicle operators) than did the conviction group (4.99% versus 4.38%).
- The TVS drivers had, on the average, fewer driver record entries than did the conviction group during the prior 2-year period.
 - The TVS group had 15.76 total crashes per 100 drivers while the conviction group had 16.32.
 - The TVS group had 31.19 total citations per 100 drivers while the conviction group had 56.32.
 - The TVS group had 0.85 major violations per 100 drivers while the conviction group had 0.96.
 - The TVS group had 7.10 TVS dismissals per 100 drivers while the conviction group had 15.12.
 - 1.24% of the TVS group was involved in a crash occurring at night while 1.40% of the conviction group was involved in a crash occurring at night.
 - 3.80% of the TVS group was involved in a fatal/injury crash while 4.02% of the conviction group was involved in a fatal/injury crash.

All prior driver record differences imply a lower pre-existing crash risk for TVS drivers. However, it should be noted that although almost all of the differences between the groups were statistically significant, this does not mean that almost all were large or of any practical or substantive importance. For example, the difference in driver age is too small to introduce a meaningful bias on subsequent crash rates.

Question 2 - Are TVS Attendees as a Group More, Less, or Equally Likely to be Involved in Future Traffic Crashes Than are Violators Receiving a Conviction?

Table 2 displays the 1-year subsequent crash rates for the TVS and convicted drivers. In this actuarial comparison, the means are not adjusted for any pre-existing between-group differences on potentially biasing variables using propensity score stratification.

Table 2
Comparison of Treatment Groups on 1-Year Subsequent Total
Crash Rate before Propensity Score Stratification

Group and performance index	Total crashes per 100 drivers
A. TVS group	11.29
B. Convicted group	10.77
C. Net difference (A-B)	0.52
D. Percentage difference ([A-B]/B)x100	4.83
E. Level of statistical significance (<i>p</i> -value)	< .0001

The TVS group had a significantly higher ($p < .0001$) 1-year subsequent total crash rate, indicating that it represents a higher actuarial crash risk than does the conviction group.⁶ The 11.29 crash rate per 100 TVS drivers is 4.83% higher than the 10.77 crash rate per 100 convicted drivers.

Although the direction of the finding reported in Table 2 is certainly remarkable due to the lower 2-year prior crash risk of TVS drivers, the comparison is still biased because the 1-year subsequent total crash rates were not statistically adjusted for any preexisting differences between the two groups. The preexisting differences lead to the following question: What would the expected magnitude of the difference in subsequent crash rates be if the two groups were equivalent on the covariates in the prior period? To answer this question, the propensity score technique was used to adjust the subsequent crash rates for the biases shown in Table 1. This question is explored in the following section.

⁶To explore the possibility of a crash-reporting bias affecting the results, the proportion of fatal/injury crashes to total crashes was calculated for each group. The number of casualty crashes forms a relatively “clean” measure because these crashes are usually much less subject to non-reporting than are property-damage-only crashes. If a reporting bias were present, one would expect the artifact to result in a sizable proportional difference between the two groups. However, the proportion of fatal/injury crashes to total reported crashes was approximately equal for the two groups (.302 for the TVS group versus .302 for the conviction group), and the difference was not statistically significant ($p > .05$).

Question 3 - Is the Law Allowing Violators to Avoid Accumulating Traffic Convictions by Attending TVS Associated With a Decrease or Increase in Traffic Crash Risk?

Propensity score stratification. As discussed above, the two treatment groups did not have similar “pretreatment” characteristics. Differences in their characteristics are, in part, attributed to self-selection and other selection biases that may be operating within the TVS program.

To statistically equate the two groups on the potentially biasing preexisting differences, the propensity score stratification technique described in the Methods section was applied to the TVS and conviction group drivers.⁷ Table 3 presents the mean propensity scores and sample sizes for the five quintiles formed by the propensity score stratification. The similarity of the mean propensity scores in each quintile indicates that the propensity score technique was successful in equating the two groups within each quintile on the scalar summary (logit) of all the potentially biasing pretreatment characteristics for which data were available.

Table 3
Mean Propensity Scores by Quintile and Group

Quintile and treatment group	Mean propensity score	Sample size
Quintile 1		
TVS driver	.3475	26,509
Convicted driver	.3245	54,758
Quintile 2		
TVS driver	.5051	38,666
Convicted driver	.4995	42,602
Quintile 3		
TVS driver	.5558	46,748
Convicted driver	.5548	34,515
Quintile 4		
TVS driver	.5798	47,056
Convicted driver	.5799	34,215
Quintile 5		
TVS driver	.6197	51,429
Convicted driver	.6196	29,839

⁷The multiple logistic regression summary table consisting of the 33 discriminating variables used in the propensity score stratification model is available to the interested reader upon request.

To further assess the adequacy of the propensity score stratification technique in reducing bias, the TVS and convicted group drivers were compared on each of their pretreatment characteristics after adjusting for their propensity score quintile. This was accomplished by using a two-way analysis of covariance (ANCOVA) model which included the main effects for propensity score quintile (coded as 1 through 5) and treatment (coded as 1 for TVS subjects and 0 for conviction subjects).⁸ The results indicate that the background characteristics which were significantly different between the two groups prior to stratification were either non-significantly different or only marginally significantly different after adjustment for the propensity score quintile. For example, Table 4 illustrates the bias reduction for the covariates whose initial bias was greater than 20%. As observed from the table, each of the covariates had a bias reduction of over 60% after stratification on the propensity score.

Table 4

Percent Reduction in Bias (Difference Between Treatment Group Means) for
Variables with Initial Bias Greater Than 20 Percent

Variable	Initial bias	Bias after adjustment for propensity score strata	% of bias reduction
Total citations	25.13	3.15	87.47
Countable citations	16.84	0.69	95.90
Driving with an S/R license	0.44	0.16	63.64
Neg-op points	9.78	0.09	99.08
TVS dismissals	8.02	0.75	90.65
Days under an S/R action	11.86	2.25	81.03
Days on probation	0.69	0.09	86.96
% under an S/R action	4.12	0.61	85.19
% with reckless conviction on record	0.05	0.00	92.80
% incident while under an S/R action	1.23	0.41	66.67
% under an FR or insurance proof failure S/R action	0.30	0.01	97.33
% under a NOTS S/R action	0.18	0.03	83.33
% under other S/R reason action	2.22	0.64	71.17

Note. The percent of bias reduction equals $100(1-(ba/bi))$, where ba and bi are the differences in covariate means after stratification and initially, respectively.

⁸Summary tables of the ANCOVA results are available upon request. The interested reader is referred to Wildt and Ahtola (1978) and to Tabachnick and Fidell (2001) for a detailed discussion of ANCOVA.

Adjusted subsequent total crashes. Several options existed to estimate the impact of the TVS dismissal policy on subsequent crash rates. One was to estimate the treatment effects separately within each propensity score quintile and then combine the quintile estimates into an overall estimate of the TVS treatment effect. An alternative was to perform a multiple negative binomial regression with the count of subsequent total crashes as the criterion or outcome variable, the propensity score (not strata) as a covariate, and group membership (TVS vs. conviction) as the treatment or independent variable. It was decided to use this alternative approach, but with the inclusion of total prior incidents as an additional covariate in the model. The primary advantage of this method is that it allowed for the assessment of the effect of primary interest in this section, the potential interaction between treatment group and prior driving incidents (defined as the sum of traffic crashes and convictions). That is, it made it possible to determine if the size of the difference between the subsequent traffic crash rates for the two groups was related to number of prior driving incidents after adjusting for propensity score.

Table 5 summarizes the results of the negative binomial regression analysis for 1-year subsequent total crashes. The interaction between treatment and prior traffic incidents is statistically significant (Wald $\chi^2 = 4.68, p = .03$).⁹ This indicates that the magnitude of the treatment effect (i.e., the increase in subsequent crashes associated with TVS) varies as a function of the number of prior incidents. Follow-up statistical tests (not displayed) on crash rate differences showed that the TVS group has a significantly higher adjusted crash rate within each prior incident level.¹⁰

⁹ In an attempt to further isolate the treatment effect of TVS dismissals versus convictions, a supplementary analysis was conducted on drivers who had no TVS dismissals or traffic convictions of any kind during the 1-year prior or 1-year subsequent periods. The rationale for such an analysis is to eliminate any confounding treatment effect that may be attributed to an additional TVS dismissal or traffic conviction during the criterion period of interest. Results from this analysis indicated that TVS drivers had a significantly higher ($p < .01$) adjusted 1-year subsequent crash rate per 100 drivers than did the convicted drivers (9.5 versus 8.6, respectively).

¹⁰ Since the follow-up tests involved comparing the group means at multiple levels of prior incident count, a Bonferoni procedure was used to adjust alpha levels for the significance tests based on the numbers of tests that were done. The interested reader is referred to Aiken and West (1991) and to Huitema (1980) for a discussion of the use of the Bonferoni procedure in this context and for a detailed discussion of testing and interpreting interactions produced from a multiple regression model.

Table 5
Summary of Negative Binomial Regression Analysis
for 1-Year Subsequent Total Crashes ($N = 378,578$)

Source	Regression coefficient	Standard error	χ^2	p
Constant	-2.2595	0.0077	86,124.00	< 0.0001
Propensity score	-0.1045	0.0635	2.71	0.099
Prior incidents	0.1277	0.0072	313.33	< 0.0001
Group	0.0859	0.0102	71.54	< 0.0001
Group X prior incidents	0.0183	0.0085	4.68	0.0305

-2 log likelihood for intercept only = 267,852.84

-2 log likelihood for intercept and covariates = 267,065.94

χ^2 for covariates = 786.90, $p < .001$

Note. The prior incidents and propensity score variables were centered about their respective means. The centering reduces the possibility of computational difficulties associated with multicollinearity in models involving interaction terms. The interested reader is referred to Aiken and West (1991) for a discussion on the centering of variables in multiple regression models employing interaction and higher-order polynomial terms.

Table 6 presents the propensity-score-adjusted 1-year subsequent total crash rates and the relative risk ratio for the treatment groups both overall and at each prior-incident level. The crash risk ratios were computed by dividing the crash rate for the TVS group by the crash rate for the conviction group within each prior incidents level and overall.

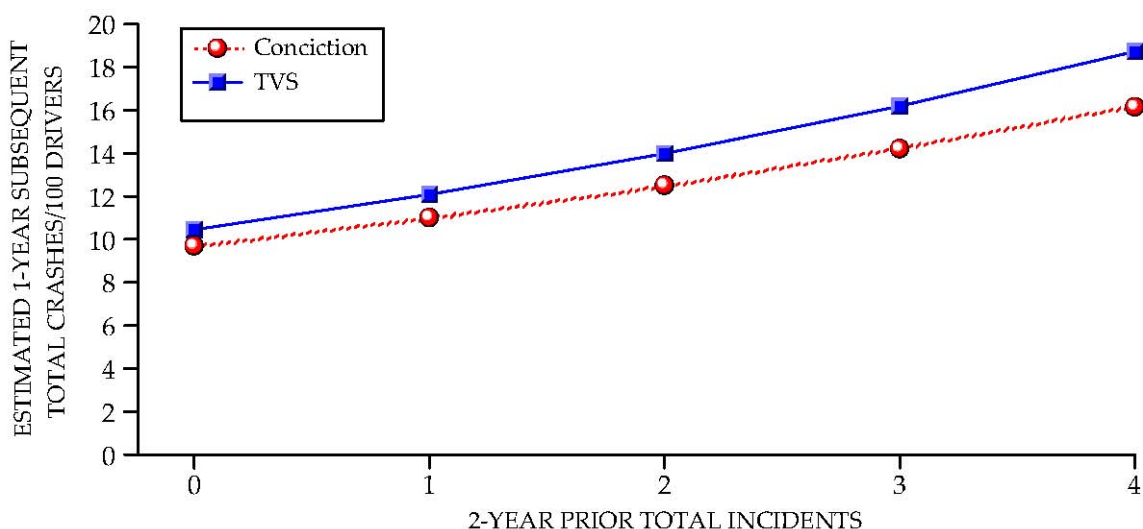
Table 6
Estimated Propensity-Score-Adjusted 1-Year Subsequent Total Crashes Per 100
Drivers and Relative Risk Ratio by Group and 2-Year Prior Total Incidents

Prior incidents	Treatment group		Relative risk ratio
	Conviction	TVS	
0	9.69	10.45	1.08
1	11.01	12.09	1.10
2	12.51	13.99	1.12
3	14.21	16.19	1.14
4	16.15	18.73	1.16
Total	10.43	11.46	1.10

Note. Prior incidents include all convictions, TVS dismissals, FTAs, and crashes, except the incident resulting in group assignment. The crash rate entries shown for total prior incidents were estimated from a main-effects regression model (Wald $\chi^2 = 86.46$, $p < .0001$).

Overall, the TVS group had a higher subsequent total crash rate than did the conviction group (11.46 versus 10.43 crashes per 100 drivers). The overall relative risk ratio of 1.10 (obtained by dividing 11.46 by 10.43) indicates that the adjusted subsequent crash rate for TVS drivers is 1.10 times (or 10%) higher than the adjusted subsequent crash rate for conviction drivers.

The results in Table 6 also indicate that the TVS group had a higher subsequent crash rate at each prior-incident level. For example, among drivers with four prior incidents, the TVS group had a rate of 18.73 per 100 drivers while the conviction group had a rate of 16.15 per 100 drivers. The relative risk ratio of 1.16 indicates that the rate for TVS drivers with four prior incidents is 1.16 times (or 16%) higher than the rate for conviction drivers with four prior incidents. The adjusted crash rates for both groups at successive prior-incident levels are shown in Figure 1.



Note. Prior incidents include all convictions, TVS dismissals, FTAs, and crashes, except the incident resulting in treatment assignment.

Figure 1. Estimated propensity-score-adjusted 1-year subsequent total crash rate by group and 2-year prior total incidents.

Sensitivity analysis. In assessing these results, one cannot exclude the possibility that unmeasured characteristics (e.g., exposure variables such as mileage) may have jointly influenced both treatment group assignment (TVS versus conviction) and subsequent total crash rate. The omission of such variables from the analyses would violate the assumption of “strongly ignorable treatment assignment,” which requires that no

measured or unmeasured characteristic predicts both treatment assignment and the total crash outcome independent of the estimated propensity score.

A sensitivity analysis was conducted (Gebers, in progress) to explore the potential impact on the results reported in this section of a violation of the strongly ignorable treatment assignment assumption.¹¹ This analysis was designed to answer the following question: How strong would an omitted confounding variable have to be to alter the conclusion in relation to the propensity-score-adjusted total crash rates for the TVS and conviction samples?

To conduct the sensitivity analysis, 25 artificial confounding covariates were generated through the use of regression equations employing as predictors the standardized residuals from the regression model that was used to estimate the propensity score. The results of the sensitivity analyses show that the independent influences of any confounders on both treatment assignment and the total crash outcome would need to be very strong to substantially reduce the estimated impact of TVS citation dismissals on the subsequent total crash outcome.

Replication study. As stated in the Methods section, the analysis done to answer Question 3 was replicated by using two different groups of drivers, TVS ($n = 209,884$) and convicted ($n = 168,312$), all of whose driver licenses ended with the number 5. The first 1-point traffic violation occurring between January 1, 2000 and December 31, 2001 served as the critical incident for group assignment.

Figure 2 illustrates the statistically significant ($p < .01$) interaction between the two groups and prior incidents found in the replication analysis. As was the case in the previous analysis, TVS drivers had higher propensity-score-adjusted 1-year subsequent crash rates at each prior-incident level.

¹¹This technical paper, describing in detail the sensitivity analysis conducted for this study, is available upon request. For an applied example of a sensitivity analysis in relation to propensity score adjustment, the interested reader is referred to Bingenheimer, Brennan, and Earls (2005) and the supporting material available on-line at www.sciencemag.org.

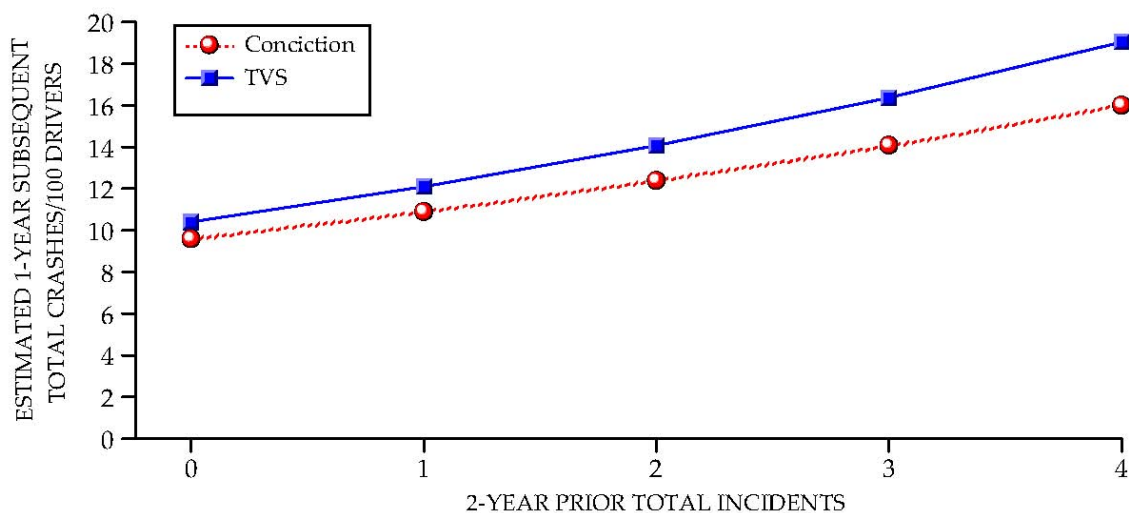


Figure 2. Estimated propensity-score-adjusted 1-year subsequent total crash rate by group and prior 2-year total incidents (replication analysis).

Results from this replication analysis closely parallel those from the prior analysis and, along with the results from the sensitivity analysis described above, provide strong substantiation for the validity of the findings.

Question 4 - How Many Crashes are Prevented or Created Each Year by the TVS Citation Dismissal Policy and What are the Economic Consequences of This Effect?

The ultimate goal of any driver improvement or educational program is to prevent crashes. If the TVS citation dismissal policy is more effective than the standard adjudication process of conviction, it is expected that TVS drivers would be involved in fewer crashes than convicted drivers with the same pre-existing characteristics. However, based on the findings presented above, this is obviously not the case.

Table 7 provides estimates of how many more 1-year subsequent crashes TVS drivers incur as a result of having their citations dismissed rather than being convicted. These figures were obtained by multiplying the estimated number of additional crash involvements per driver for the TVS group (the difference between .1146 and .1043) by the approximate annual (2000-2001) volume of TVS referrals (1,200,000). As shown, approximately 12,311 crashes per year are attributable to the TVS dismissal policy.

Table 7

Estimated Number of Total Crash Involvements and Economic
Cost Attributed to the TVS Dismissal Policy

Effect size (per driver)	Annual number of TVS dismissals	Number of crashes attributed to the TVS program	Cost of crashes attributed to the TVS program	Cost savings attributed to NOTS level 3 & 4 circumventions	Net TVS program costs
0.010259	1,200,000	12,311	\$398,697,014	\$531,870	\$398,165,144

Note. The economic cost of crashes attributed to the TVS dismissal policy is based on an estimated per crash cost of \$32,386 (expressed in 2002 dollars). This cost was derived by applying California Department of Transportation's unit costs for fatal, injury, and property-damage-only crashes to the volumes of these kinds of crashes in the California violator sample.

An estimate of the cost of crashes attributed each year to the TVS dismissal policy is provided in the last column of Table 7. The average crash cost of \$32,386 used to derive this estimate was obtained by multiplying the California Department of Transportation's (Caltrans) estimates of the unit costs (in 2002 dollars) of fatal, injury, and property-damage-only crashes by the proportion of each crash type among the TVS population (California Department of Transportation, n.d.). The Caltrans cost model reflects the direct and indirect costs incurred by the involved individuals and the larger society. Multiplying the \$32,386 value by the estimated number of crashes attributable to the TVS dismissal policy (12,311) yields an additional estimated gross economic cost of \$398,165,144 created by the TVS policy.¹²

Question 5 - How Many of the Department's Negligent-Operator Treatment System Actions are Circumvented Annually Due to Drivers Receiving One-or-More TVS Dismissals?

The NOTS program consists of four levels of intervention designed to treat individuals who accumulate neg-op points due to traffic convictions and traffic crashes for which they are deemed responsible. Appropriate actions are administered when the number of neg-op points reaches certain levels accumulated over periods of 1, 2, and 3 years. A driver is classified as a negligent operator when the driver accumulates the point

¹²The two most common strategies for costing traffic crashes are (1) human capital/production loss models and (2) willingness to pay (WTP)/comprehensive models. Under the former, costs include all direct economic losses associated with a traffic crash. By far, the largest component of this cost is lost future earnings (e.g., injuries, fatalities, time lost from work). Under the WTP/comprehensive cost method, estimates reflect the direct and indirect costs incurred by the involved individuals as well as those of the larger society and, therefore, result in higher crash costs than those associated with the human capital/production loss models. The WTP/comprehensive cost method was used in the present study as it is the method recommended by the National Safety Council (2002) for use in cost benefit analyses of traffic crashes. The interested reader is referred to Peck and Healey (1995-96) for a discussion of the average cost of California crashes by type for the two costing models.

criteria for a Level 3 or Level 4 action (see below). The four levels of intervention for non-commercially licensed drivers (i.e., drivers of other than commercial vehicles) are the following:¹³

Level 1. Warning letters sent to drivers who have two points in 1 year.

Level 2. Notices of intent to suspend sent to drivers who accrue three points in 1 year, five points in 2 years, or seven points in 3 years.

Level 3. Probation/suspension hearings required for drivers who accrue four-or-more points in 1 year, or six-or-more points in 2 years, or eight or more points in 3 years. The Level 3 action consists of a 1-year probation with a 6-month suspension. Drivers requesting and attending a hearing receive the 1-year probation along with suspension usually lasting for 30 to 90 days.

Level 4. Probation-violator sanctions administered to drivers who accumulate any additional neg-op points, or who fail to appear in court in connection with traffic citations, during the Level 3 probationary period. Suspensions last for 30, 60, or 90 days for the first violation of probation and 6 months for the second and third violations. A fourth violation of probation results in license revocation.

The interested reader is referred to Gebers and Roberts (2004) for a detailed description of NOTS and to Peck and Healey (1995) for a summary of the department's traffic safety evaluations of the four NOTS interventions.

As detailed in the Methods section, the NOTS sample of 47,465 drivers and the TVS Finder Record sample of 106,649 drivers were used to calculate the number of neg-op points and TVS dismissals accumulated for 1-, 2-, and 3-year periods. Drivers in the NOTS sample had a conviction resulting in a NOTS action updated on their driving record in years 2002 or 2003. Drivers in the TVS Finder Record sample had a TVS dismissal updated at DMV during the same time period. These two groups do not overlap, since all of those with neg-op actions were excluded from the TVS Finder Record group.

TVS dismissals would have reduced the overall point count of TVS participants from what it would otherwise be, which would have resulted in a corresponding decrease in the annual volume of neg-op interventions for these drivers. Estimates of the number of Levels 3 and 4 neg-op actions that were circumvented as a result of the TVS

¹³Drivers holding a commercial license generally receive an increased number of neg-op points for offenses taking place in heavy commercial vehicles, but are allowed more points before a NOTS licensing action is imposed. Therefore, this group of drivers was not included in this section.

dismissals are presented in Table 8. The estimates were derived by counting TVS dismissals as if they were neg-op points, adding this count to the number of neg-op points, and then determining the increase in the number of drivers who would then have sufficient points to qualify for Level 3 and Level 4 actions. If drivers in the NOTS and TVS samples had been convicted instead of receiving TVS dismissals, it is estimated that an additional 2,216 drivers would have received Level 3 actions over a 1-year period.

An estimate of the number of Level 4 actions was also calculated. However, it was necessary to take into account the potential deterrent effect of hypothetical Level 3 actions upon the NOTS Levels 1 and 2 and TVS drivers. According to Peck and Healey (1995), subsequent 1-year convictions of NOTES drivers in their study were reduced by 12% following the administration of Level 3 actions. Consequently, the estimated number of Level 4 actions prevented by TVS dismissals was similarly reduced by 12% for the above listed groups.

Table 8 shows that the estimated number of Level 4 actions circumvented by TVS dismissals in the TVS sample was 70, while the estimated number of Level 4 actions circumvented by TVS dismissals in the NOTS group was 1,424. Projecting these sample figures to the total California population, 15,335 Level 3 and 5,888 Level 4 interventions were circumvented because of TVS dismissals over a 1-year period.

Table 8

Number of NOTS Level 3 and Level 4 Actions Circumvented in 1 Year
Due to TVS Dismissals (Non-Commercial Drivers Only)

Actions circumvented by TVS dismissals	TVS sample	NOTS sample	Projected statewide total
Level 3	396	1,820	15,335
Level 4	70	1,424	5,888

Considering that NOTS Level 3 and Level 4 actions have been shown to be effective in reducing crashes (Peck & Healey, 1995,) and that the present study verifies prior departmental findings on a negative traffic safety impact of the TVS citation dismissal policy, it can be considered that the driving public is exposed to increased crash risk through the circumvention of the NOTS Level 3 and Level 4 actions.

DISCUSSION/CONCLUSIONS

This study employed methodological refinements over prior evaluations of the TVS citation dismissal policy. The findings closely parallel those of the Department's 1991 study of the traffic safety impact of traffic violator school citation dismissals (Peck & Gebers, 1991). The following conclusions are warranted by the findings:

1. Prior to treatment assignment, TVS attendees have characteristics associated with a lower subsequent crash expectancy compared to drivers who receive conventional court adjudication (conviction).
2. Despite their preexisting lower-risk characteristics, TVS attendees have a significantly higher rate of subsequent crashes compared to those who are convicted of their traffic violations.
3. Propensity-score adjustment of the observed crash rates to control for preexisting biases between the TVS and conviction groups increases the magnitude of the difference between their subsequent crash rates. Without the adjustment, the TVS group has a 1.05 times, or 5%, higher crash rate than the convicted group. After the adjustment, the TVS group has a 1.10 times, or 10%, higher crash rate than the conviction group.
4. The apparent negative traffic safety impact of the TVS citation dismissal policy increases as the number of prior driver record entries increases. Although TVS attendees had significantly more subsequent crashes at all prior incident levels, the increase was considerably larger among TVS attendees with four prior entries than among those with no prior entries.
5. The 10% increase in crash risk attributed to the TVS dismissal policy results in approximately 12,300 traffic crashes annually for the 1.2 million drivers receiving TVS dismissals each year. The net annual economic dollar loss associated with these crashes is estimated by the comprehensive crash cost model to be about \$398 million.
6. It was estimated that approximately 15,000 Level 3 and 6,000 Level 4 NOTS interventions are circumvented annually because of TVS dismissals. The demonstrated effectiveness of the NOTS interventions in reducing the crash risk of treated drivers helps explain why the driving public is exposed to an increased crash risk as a result of their avoidance.

As stated above, the present study employed methodological refinements to the procedures used in prior departmental evaluations of the TVS citation dismissal policy. However, as with any study employing a quasi-experimental design in which

assignment to treatment is not random, it is essential to discuss and evaluate the potential threats to the internal validity of the study. Prior to doing so, it is instructive to examine which of the above conclusions are subject to alternative explanations or bias.

Conclusions 1, 2, and 6 follow directly from the data. Their validity relies solely on the reliability and precision of the sampling.

Conclusions 3, 4, and 5 involve inferences of causality that the differences in the adjusted crash rates found in the primary and replication analyses were likely the result of type of treatment (i.e., TVS versus conviction). These inferences require that the influence of any important preexisting differences between the TVS and conviction groups had been adequately and statistically controlled in the analyses. It is certainly possible to question this assumption by invoking the possibility of the existence of one or more latent uncontrolled variables that represent some factor that influenced subsequent crash risk but on which the two groups still differed after the propensity score adjustment. For example, annual mileage and other aspects of exposure related to crash risk were not available for use in calculating the propensity score. The exclusion of such variables raises the possibility that not controlling for possible differences between the groups on these variables biased the findings against the TVS group. Such an effect might occur, for example, if the TVS group drove more miles in the subsequent period than did the conviction group. However, as stated in a similar discussion by Peck and Gebers (1991), there are reasons for rejecting this argument.

First, the direction of the biases on known correlates of exposure (e.g., prior crashes, prior convictions, license class, and gender) is predictive of higher mileage for the conviction group. If anything, the direction of the relationships is more consistent with the hypothesis that the TVS group drove less, at least during the prior period. Second, if for some reason the TVS group tended to be higher-mileage drivers and if the corresponding adjustment was made, then the prior driver record differences favoring TVS attendees would become even larger in terms of the number of crashes per mile driven. Prior research has consistently demonstrated that the number of prior driver record entries to be the best single predictor of future crash risk (Gebers, 1999; Gebers & Peck, 2003; Peck & Kuan, 1983). Third, irrespective of any of the preceding points, the results of the sensitivity analysis demonstrate that the differences in exposure or in any other omitted variable would have to be very substantial to “explain away” the differences in subsequent crash risk. Peck and Kuan (1983) demonstrated that the relationship between miles driven and crash frequency is not very strong.

There is one situation in which the conviction group might have driven fewer miles than the TVS group in the subsequent period, but for which it would be incorrect to make a statistical adjustment. This would be the case if the conviction itself causally influenced or reduced the amount of driving in the subsequent period. For example,

such an effect might occur as a result of drivers in the conviction group receiving more DMV license suspensions in the post-conviction period as a result of accumulating more NOTS points. In this situation, the reduced mileage would be a legitimate source of the conviction's effect and, therefore, it would be inappropriate to adjust the crash rates for the differences in mileage.

Recent research by Chandraratna, Stamatiadis, and Stromberg (2006) provided an important insight to the above discussion. These authors investigated the crash risk of Kentucky drivers receiving traffic violator school citation dismissals. They reported that traffic school attendance is associated with higher odds of being a culpable party in a crash involvement. The finding that a negative traffic safety impact of traffic school dismissals extends to culpable crash involvement is noteworthy because the technique used by Chandraratna et al. provides some control over exposure, lending further substantiation to the above discussion that mileage differences probably do not explain away the results in the present study.

Another uncontrolled variable warranting acknowledgement is insurance status. It is likely that the TVS group had a higher incidence of insured drivers than did the conviction group, since avoiding increased insurance premiums is one of the primary reasons violators choose the TVS option. Such a bias would likely favor the TVS group, because being uninsured is associated with a lower socioeconomic status, and both are known to be associated with increased crash risk (Harano, McBride, & Peck, 1975; Peck & Kuan, 1983). An analysis of the aggregated ZIP code indices used in the 1991 TVS study by Peck and Gebers suggested that drivers receiving a conviction tended to reside in lower-income areas as compared to drivers receiving a TVS dismissal. However, this potential bias was controlled to some extent in the present study by the use of the geographical residential indicator variables in the computation of the propensity score.

The interaction with prior driving record is exactly the effect that would be expected from the department's license control interventions being withheld from a group. The current study estimated that approximately 21,000 NOTS license control interventions are circumvented annually due to the TVS dismissal policy. Since these NOTS actions have been found to be effective in experimentally controlled evaluations (Peck & Healey, 1995), it should not be surprising that a policy that allows traffic offenders to circumvent license actions might lead to an increase in crashes. If such an effect were to occur, it would be most apparent in drivers approaching California's *prima facie* negligent operator level of four points in 1 year. The results of the present study show clear evidence for the hypothesized interaction with prior driving record.

It is important to understand that it is not being suggested that avoidance of DMV licensing actions, per se, accounts for all of the increased crash risk of the TVS group. Perhaps even more important is the loss in general deterrence associated with anticipation of both increased insurance costs and possible DMV action. Gebers et al.

(1987) and Peck and Gebers (1991) have argued that the policy of dismissing traffic citations compromises the deterrent mechanisms underlying traffic law enforcement. Contingencies such as increased insurance rates and DMV actions are powerful motivators for avoiding these aversive contingencies. For the TVS program not to have a detrimental impact on traffic safety, the information and experience provided by exposure to the course would have to cause a behavioral change sufficient to offset the loss of deterrence created by the avoidance of a conviction. It seems unlikely that exposure to any brief instructional or group program would completely offset this loss in deterrent potential.

It should be noted that while the propensity score technique utilized in the present study statistically equated the TVS and conviction groups on the dimensions measured by the covariates, there are limits to the effectiveness of such statistical controls. The most substantial limitation is that in quasi-experimental designs of the kind used in the present study, it is inherently difficult to capture and measure all of the factors on which groups differ and which would impact their subsequent crash rates. Although strong statistical adjustments were employed to control potential bias between the groups, there remains the possibility (an unlikely one, though, given the results of the replication and sensitivity analyses) that uncontrolled bias operated to affect study results. Therefore, the results of the present study do not prove a negative traffic safety impact of the TVS citation dismissal policy as they illustrate relationships between the TVS citation dismissal policy and subsequent traffic crashes that are suggestive of its negative effect.

This study has demonstrated that California's current laws and policies allowing courts to dismiss traffic citations of drivers attending a TVS are associated with an increase in crashes among this group and has substantial human and economic costs. A number of changes to current laws and policies should be implemented to mitigate these costs, and these recommendations (in no particular order and may not be completely independent of each other) are presented below:

1. Assign a negligent-operator point for each TVS dismissal.
2. Unmask the original TVS dismissal whenever a driver receives a second TVS dismissal or subsequent traffic conviction within 18 months.
3. Require a driver to maintain a clean record (i.e., no convictions or culpable crashes) for 2 years prior to a violation that is dismissed by way of TVS completion.
4. Eliminate the ability of courts to dismiss more than one citation within any 18-month period via the TVS option.

5. Eliminate the ability of courts to improperly dismiss major (2-point) violations via the TVS option.
6. Send warning and advisory letters to groups of TVS drivers who, on the basis of a combination of TVS dismissals and NOTS points, do not qualify for negligent-operator treatment system intervention, but who exceed the risk of *prima facie* negligent operators.

The first listed recommendation would allow the department to take license control actions against TVS attendees who accumulate negligent driving records. The second and third recommendations would make citation masking or TVS attendance conditional upon maintaining a clean driving record, providing additional incentive for the TVS driver to remain conviction and crash free. The fourth and fifth recommendations would eliminate the negative traffic safety implications of both repeat TVS dismissals and dismissals associated with the more serious violations. The sixth recommendation follows from the report by Gebers and Peck (2003) on the development and evaluation of a risk management strategy for reducing crash risk. The central thesis of that report is that the department has grounds to intervene against any group of drivers whose demonstrated crash risk exceeds that of *prima facie* negligent operators. The authors recommend that advisory letters be sent to groups of TVS drivers who, on the basis of a combination of TVS dismissals and neg-op points, do not qualify for NOTS intervention, but who exceed the risk of *prima facie* negligent operators.

It is also recommended that any of the changes in TVS policy suggested above should, if implemented, be subjected to a rigorous scientific evaluation to determine their impact on traffic crashes and their cost effectiveness.

The present findings do not necessarily imply that TVS instruction directly causes drivers to become crash involved. The more likely scenario is that current TVS programs are simply ineffective in changing driving behavior and result in no direct impact on crashes. Consistent with prior departmental evaluations, the results from the present evaluation warrant the conclusion that whatever educational benefit there is to TVS instruction is not enough to offset the negative traffic safety impact of the citation dismissal policy.

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